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Activity, exercise and the planning and design of outdoor spaces

Abstract

This paper reviews research into the relationships between attributes of outdoor environments and levels of activity and exercise in populations using those environments. It takes an environmental designer's view of relevant and effective research and research approaches that can provide evidence for policy and practice. The paper has a tripartite structure, examining theories, research methods, and findings that contribute to understanding links between physical activity and the planning and design of outdoor spaces. It considers concepts, methods and evidence relevant to adults', older adults' and children's activities and identifies those that appear to offer greatest potential for future research. It also identifies gaps in our understanding, the need for well-conceptualized models of environment-behaviour interactions to elucidate these, and the importance of collecting and presenting evidence in ways that are sympathetic to design practice. If evidence is to lead to effective and salutogenic changes in our physical environment, then findings that translate readily into a design framework will be most beneficial.

Keywords: Physical activity, health, physical environment, environmental design, built environment, public realm.

1. Introduction

This paper is aimed at those with an interest both in the design of physical environments that might encourage less sedentary and more active lifestyles, and in the research needed to provide supporting evidence. It does not attempt to replicate the growing number of systematic reviews and other broad overviews of evidence on the relationships between physical environment and health (e.g., Frank, Engelke, & Schmid, 2003; Humpel, Owen, & Leslie, 2002;

Kazcynski & Henderson, 2007; New York City, 2010; Owen, Humpel, Leslie, Bauman, & Sallis, 2004; Sallis, 2009; Transportation Research Board, 2005). Rather, it arises from a landscape architect's perspective on what kinds of research might be useful for designers and the opportunities and challenges inherent in undertaking such work. For those unfamiliar with this domain, it provides an introduction to relevant theories and methods used in researching links between physical activity and the planning and design of outdoor spaces. It then considers findings that draw on these methods, and the gaps in our knowledge, in the hope of encouraging further research to improve our understanding of what designs work best in promoting and enhancing healthy activity in people's daily lives.

2. Background

The recently reawakened policy interest in environmental design and its potential contribution to health arises partly from the current health crises in the western world - rising levels of obesity, Type 2 diabetes, cardio-vascular disease, cancer, and mental illness – and their consequences for the cost of healthcare. Many such illnesses are not the result of exposure to pollutants or organic disease vectors but are in part the consequence of availability and choice in what food people eat, or how and where they spend their leisure time, in addition to the increasingly sedentary nature of most jobs and work contexts in the developed world. Recent research suggests that sedentary behaviour is an independent risk factor for health, above and beyond the effect of low levels of physical activity (Sugiyama, Healy, Dunstan, Salmon, & Owen, 2008). All of this indicates that individual preference and decision-making, as well as the nature of the socio-ecological context in which they occur (Evans & Stoddart, 1990; Sallis & Owen, 2002), have a large part to play in improving public health.

In a study on how to enhance population-level health in England, Wanless (2004)

modelled three scenarios based on the extent to which people successfully engaged in protecting and promoting their own health and become more engaged in managing their own care. The gap between the best and worst scenarios was around £30 billion by 2022/23, or half of National Health Service (NHS) expenditure at the time. Hence, on economic grounds alone, public policy should be increasingly focused on what interventions might enhance such public engagement in health.

In this context, there has been a renewed interest in the role of the physical environment and the particulars of place in public health (Cummins, Curtis, Diez-Roux, & Macintyre, 2007; Macintyre, Macdonald, & Ellaway, 2008; Ward Thompson, 2010b). Environmental interventions to enhance public health, so central to early health improvements in urban areas from the nineteenth century onwards, had become marginalized in the pharmaceutically focused and high-technology world of post-war 20th century medicine (Morris & Robertson, 2003). The renewed interest in physical environment is now focused on identifying and understanding *salutogenic environments*, that is, environments that support healthy behaviours and responses, recognising that such environments may have more permanent and population-wide effects than other forms of public health interventions targeted at individuals (Owen et al., 2004; Saelens, Sallis, Black, & Chen, 2003).

In Scotland, the ‘Good Places, Better Health’ public health initiative (Scottish Government, 2008) has involved the development of a model for environment and health (Morris, Beck, Hanlon, & Robertson, 2006) that attempts to identify what kinds of environmental intervention are possible and desirable, and where the most effective point of intervention might be. While changes in the design and management of work, education, leisure and home-based environments, which is where people spend most of their time, may offer

opportunities to reduce sedentary behaviour, there is also considerable interest in ways that the outdoor environment, particularly the public realm, may be designed to offer opportunities for physical activity and encourage more active lifestyles.

The health value of physical exercise has long been recognized and more recently reinforced through recommended minimum levels of healthy activity in many countries (e.g., Department of Health, 2004, 2011; Pate et al., 1995; U.S. Department of Health and Human Services, 2008). Such steps are set against well-documented evidence that populations in many countries are increasingly *inactive*. Self-reported activity levels in the US, the UK and Australia for 2007-8 show that less than half the population, and in many cases less than 30%, are achieving recommended levels of activity (Australian Government Department of Health and Ageing, 2010; CDC, 2010; NHS, 2010). A considerably more alarming picture is painted by objective measures from accelerometry: data on English adults in 2008 showed that only 6% of men and 4% of women achieved the recommended physical activity level (NHS, 2010),

There is evidence that interventions to increase moderate level physical activity by promoting activities such as walking, which require no specialist facilities, are associated with longer-term changes in behaviour than those which require specialist facilities, such as sports pitches or gyms (Department of Health, 2004). There is further interest in walking since it is available to young and old, rich and poor, and requires no skills or training. If it is possible to create attractive streets, parks and other outdoor spaces that encourage and facilitate physically active behaviours such as walking, such interventions have attraction as ‘upstream’ interventions likely to benefit health at a population level (McIntyre, 2008). For this reason, there is particular interest in how the design and management of everyday environments might support and encourage physical activity.

Alongside this interest in links between design of the environment and healthy activity levels, there has been a growing emphasis on the need to address health inequalities within and between communities as a core requirement for achieving sustainability (Marmot, 2010). Marmot's study recognised that the UK, alongside many other developed countries, still suffers from huge health inequalities that are in turn the result of other forms of inequity within society. The most notable of these is inequity in socio-economic status, and poorer communities often suffer as well from poorer quality physical environments and other forms of deprivation. If the environment has an influence on people's health, and if we can identify the key features of the environment that make a significant difference, then it is necessary to consider equity of access to health-supportive environments in order to address health inequalities. This realisation ties in to the broader concept of environmental justice (Pearce et al., 2010), and the implication is that those who do not have access to salutogenic environments are likely to suffer from a comparative lack of opportunity to lead healthy lifestyles, in turn contributing to poorer health. Thus, equity of access to environments that engender good health is a key element of sustainability, and understanding what elements of the environment are significant in contributing to health is of key importance in this regard.

In order to address such issues, this paper concentrates on the public, outdoor realm, by which I mean places that are freely available (at least in theory) to be accessed by anyone, regardless of who owns or manages the environment. It starts off by considering relevant theories and, secondly, appropriate research methods that have drawn on these theories. It then presents findings that relate to different scales and elements of the outdoor environment: the neighbourhood scale of open space (networks of streets, parks, etc., relevant to the 'walkable' urban environment), followed, at a more detailed level, by parks and natural open space, streets

and squares, and children's playgrounds. These foci emerge from my interest as a landscape architect, and therefore are biased towards parks and green or natural open space but also relate to important themes within the activity and health literature. Finally, there is a discussion of gaps, challenges and opportunities for further, robust and appropriately targeted research to inform design practice.

3. The theoretical context

3.1. Ecological approaches to environment and health

Public health policy has generally adopted a model of the relationship between environment and health that reflects, *inter-alia*, Bronfenbrenner's human ecology theory, (Bronfenbrenner, 1979, 2005), where the individual is located within nested ecological systems (Dahlgren & Whitehead, 1991; Scottish Government, 2008). Bronfenbrenner pioneered childhood studies that examined the role of multiple levels of the environment on human behaviour and development, from the intimate home and family-related micro-system, through the meso-system of the immediate physical, and socio-cultural context to the macro-system of broader environment, culture, society, politics, and so on (Bronfenbrenner, 1979, 2005). Following the early 20th century ideas of Vygotsky on childhood cognitive development, Bronfenbrenner's work underlined how the individual can exert an influence over his or her environment and, at the same time, how the environment exerts an influence on the individual.

A number of approaches to environment-behaviour research have developed versions of this ecological model, reflecting similar understandings of the transactional nature of the relationship between person and place (Ittelson, 1973; Myers & Ward Thompson, 2003). A central idea here is that people's stage and role in life, their goals and objectives, will influence their assessment of a place and how well it supports or frustrates these goals; and in turn, the

environment influences what goals and objectives seem possible or attractive. Bandura's (1989) social cognitive theory took this view further, to emphasise the way that people's behaviour is a response to what they learn from watching what others do in the context of particular physical and social environments. Such concepts have an appeal to those interested in behaviour change models, to help discern the likely effectiveness of different kinds of intervention to increase healthy behaviour and physical activity. Rhodes' (2006) work has explored how individual personality traits may be linked to different levels of physical activity in individuals and how intentions, attitudes and social norms may mediate relations among environmental characteristics and activity (in this case, walking) as well as moderate links between planned behaviour and activity levels achieved (Rhodes, Brown, & McIntyre, 2006; Rhodes, Courneya, Blanchard, & Plotnikoff, 2007).

Following these theories, recent models of public health and environment reflect the fact that individual characteristics and preferences are active within the context of socio-economic, political, cultural and environmental factors that operate at different scales, from household and community to wider geographic levels (Barton & Grant, 2006) (see Figure 1). They underline the necessity of understanding the complexity and interactivity of context and individual in any study of the relationships between environment, behaviour and health (see Figure 2). Research since the 1990s using ecological models of behaviour has increasingly emphasised the need to consider the physical environment more carefully in such studies (Bull, Giles-Corti, & Wood, 2010; Sallis, 2009; Scottish Government, 2008). This approach is of particular interest to those responsible for planning and designing the environment.

Insert Figures 1 & 2 about here

3.2. Affordances in the environment

Gibson's (1979) concept of affordance is an important feature of an ecological approach that emphasises the reciprocal relationship between perceiver and environment. James Gibson, along with his wife Eleanor (E. Gibson, 2000), developed the term 'affordances' to refer to the cues that the environment offers an individual in terms of perception and behaviour. They are "perceptual properties of the environment that have functional significance for an individual" (Heft, 2010, p. 18). This concept of environmental affordance has played an important part in the subsequent development of research into landscape and environmental preference as well as environment-behaviour interactions. By emphasising the information available from the surrounding environment as a key element of landscape users' perception and action, the concept is attractive to planners and designers because it opens up ways to consider how the physical environment might be managed or manipulated to support different human experiences and activities.

Affordances, says Heft (2010), are properties of the environment that are both objectively real *and* psychologically significant. He has described how affordances can be seen as opportunities for action – highly relevant in the context of environment and physical activity. He makes clear that some environments attract action and others repel, and that such relationships are culturally laden. Thus affordance as a concept offers a theoretical stance that highlights the relationship between functional properties of environmental features and the characteristics – physical, cognitive and emotional – of individuals.

3.3. Behaviour settings

Related to the concept of affordance is the notion of behaviour settings – contexts for behaviour that arise from social and environmental structures. An example of a behaviour setting might be a school class session. As this example illustrates, behaviour settings support

recurring patterns of activity (Barker, 1976). Barker's identification of these structured contexts in which "standing patterns of behaviour" can be observed (Schoggen 1989, p. 2) arose from the observation that children's behaviour varied less across different children within a given setting than across the same child in different settings. Thus, certain physical types of place (and their socio-cultural context) elicit certain types of behaviour that are predictable. Affordances are among the environmental properties that contribute to the functioning of a behaviour setting. For example, repeated behaviour patterns of young adults playing informal football may be observed in grassy open spaces above a certain size (i.e., properties affording a football game) located in public parks, while such behaviour would not be found in similar sized lawns in front of corporate buildings, or in very small and subdivided grassy plots in a public park (see Goličnik & Ward Thompson, 2010, for further such examples). Behaviour settings offer a useful unit of analysis for understanding how aspects of environmental design and their context are related to people's activities in social settings.

One aspect of the environment relevant to behaviour settings and affordance, particularly in relation to places that are attractive for relaxation or relief from stress, is aesthetic quality. In the outdoor environment, natural elements play a key role in aesthetics, and theories of landscape aesthetics may help in understanding how people choose, or respond to, different settings for their activities.

3.4. The influence of aesthetics and nature

There is a considerable body of work on theories of aesthetics and preference in relation to landscape perception (e.g., Berleant, 1992; Bourassa, 1991; Carlson & Berleant, 2004; Gobster, Nassauer, Daniel, & Fry, 2007; Nasar, 1988; Ribe, 1989;). This work has fed an interest in the role of landscape and the natural environment in health, drawing to a greater or lesser

extent on evolutionary theories, and pointing in particular to landscape's relationship with mental well-being. The biophilia hypothesis (Kellert & Wilson, 1993), the psycho-evolutionary theories of researchers such as Orians & Heerwagen (1992) and Ulrich (1999), and the attention restoration theory of Rachel and Stephen Kaplan (1989, 1995) attempt to explain why certain types of environments, particularly natural ones, appear to be effective in stress reduction and restoration from fatigue. By contrast, there has been little such research on what it is about landscape perception and experience that elicits activity and physical exercise or energetic behaviors for their own sake (as opposed to in contexts of 'fight or flight'). Yet if people are to be encouraged to engage in more active lifestyles, then better theoretical understandings about why different landscapes might elicit healthy exercise are needed (Nelson, Wright, Lowry, & Mutrie, 2008).

The challenge is to establish the direction of any relationship between attractive environments (natural or otherwise), physical activity, mental health, social engagement and well-being. Hartig (2007, 2008) proposed that the mechanisms that link the natural environment with psychological restoration and with physical activity are intertwined, and it seems likely that this is the case. Rhodes et al. (2006) suggested that attractive neighbourhoods contribute to positive attitudes and social norms that encourage walking, while having close access to recreational facilities such as parks increases the likelihood that people will translate walking intentions into actual action. Bowler, Buyung-Ali, Knight and Pullin (2010) posited that the health effects of natural outdoor environments may result from a combination of the mental and physiological effects of activity as well as participation in social activities and engagement with others. For those interested in design of outdoor environments to enhance physical activity, there is a need to understand better the comparative importance of attractors in terms of physical

activity, psychological well-being and social contact, and to know in particular whether attention to designs that enhance the last two is likely to encourage greater physical activity.

3.5. The individual and the environment

While affordance and the attractiveness of behaviour settings are particularly valuable concepts in helping to understand how design of the environment might influence behaviour, an ecological approach demands that there is also a focus on the individual and on understanding personal differences in needs, experiences and desires in relation to the environment. Much of the work behind ecological models of environment-behaviour interaction comes from studying children and their development, often with an interest in factors that appear to be universal. When older adults are considered, individual factors and differences tend to be thrown into greater perspective. Reflecting this, Lawton and Nahemow (1973) developed an Ecological Model of Ageing that introduced the concept of environmental press – the differential effect of the environment on behaviour that relates to the capabilities and characteristics of the individual (Bonnes & Secchiaroli, 1995). This proposal is helpful in focusing attention on ways that the same environment may offer different kinds of opportunities or barriers to different people and their activities.

Kelly's (1955) personal construct theory offers an alternative way of considering how the environment provides a range of opportunities or makes demands on people according to their individual traits, wants and needs. Kelly emphasised engaging directly with people - "...ask them, they may tell you" – to understand their personal constructs (Centre for Personal Construct Psychology, 2009). These constructs are posited as the medium through which individuals understand the world and its meanings, predict what to expect from their environment, and modify their predictions in the light of experience. According to Kelly, some constructs become

core role constructs, centrally important to the lives of individuals. Such concepts have been drawn on by others (e.g., Little, 1983, see below) to develop methods that illuminate the way different environments may affect or relate to core constructs, and may satisfy or confound an individual's expectations of those environments.

3.6. Environmental support for outdoor activity

Building on notions of environmental press and the transactional relationship between people and place, models of environmental fit (Carp & Carp, 1984; Kahana, 1982; Lawton, 1980) have been developed to describe how the environment can become a limiting factor on people's mobility as their functional capabilities change in old age (Iwarsson, 2005). Related to this concern, the concept of environmental support builds on the work of Kelly (1955), and followers such as Little (1983), by placing the focus on a person's desired and necessary activities in relation to the attributes of their environment. Environmental supportiveness is seen as the extent to which the environment helps or hinders physical activity (Sugiyama & Ward Thompson, 2007a, 2007b), and allows for notions of positive attractors in the landscape or environment (such as good quality paving and tree-lined walks) as well as limitations (such as dog fouling) which inhibit or prevent activity (e.g., Borst et al., 2009; Sugiyama & Ward Thompson, 2008). Environmental supportiveness thus builds on the idea of aesthetics and affordances that can elicit activities, drawing people into perhaps unplanned behaviour because the environment makes doing so easy and enjoyable.

The models and concepts that have been outlined above provide the theoretical foundations for recent research on links between environmental design and different kinds and levels of activity. A range of methods that draw on these theories is discussed next, before a final section reviewing findings relevant to different environmental contexts and levels of detail.

4. Methods used in researching links between physical activity and the planning and design of outdoor spaces.

The methods described here are of particular interest because have been effective in research with a focus on activity in the outdoor environment. They have been chosen because they offer valuable approaches to understanding the different issues and because they provide the kind of evidence that appears to be useful for planners and designers of the physical environment.

4.1. Behaviour observation in the public environment

The application of Barker's theory of behaviour settings, and the value of behaviour observation within such settings so as to understand what the physical environment affords, is evident in the work of Kevin Lynch. Lynch was a key figure linking theory to practice in planning and design; and his canonical text on Site Planning, first published in 1962, supported Barker's approach. Lynch argued for a focus on people's activities rather than the traditional planner's focus on physical elements alone. Conventional planning, he said, results in places where "People struggle to carry out what they want to do, and the environment is thought to be timeless. We do not learn better ways of supporting behavior, nor do we discover how to open up new possibilities" (Lynch, 1971, p. 26). Instead, Lynch argued, behaviour observation should be an essential part of design in order to understand what people actually do on a site, or on similar kinds of sites, so as to inform new planning: The designer must know the people who will use the site; he must understand their wants and manner of life or how they hope to modify their manner of life. He puts himself in their place and [...] goes through the actions that will fill their lives there. What will it be like to mail a letter, talk to a neighbor, display wealth, dispose of trash, seek adventure? (Lynch, 1971, p.37). Lynch's focus on activities or behaviours, such as

walking, waiting, chatting, or kicking a ball about, rather than on labels of formal design features, such as footpath, bus shelter or car park, turns the designer's attention immediately onto the people for whom the place is intended, and includes those who might enjoy the place even if they are not the primary or initial focus of attention. This orientation is very much in the spirit of the affordance concept and was an early encouragement to designers to think more creatively about places that might elicit different kinds of activity. Lynch's insights informed his important studies of children's urban environments, repeated in surveys of the 'Growing up in Cities' project, that have explored the opportunities for children's activities in different international urban contexts (Chawla, 2002; Lynch, 1977).

In their studies of children's activity in different play environments, Moore and Cosco (Cosco, 2007; Moore, 1974; Moore & Cosco, 2007; 2010) have described in detail the use of behaviour settings to analyse systematically what it is about the design of different physical elements that attract (or deter from) use and activity. Their work is valuable in illustrating how to identify behaviour settings, how to record behaviour in each of these settings, and how to analyse and present meaningful results. They distinguish between play involving sedentary or comparatively light activity and more vigorous activities, demonstrating how to identify behaviour settings that best support high intensity physical activity as well as those associated with sustained activity (often of lower intensity) over time.

A more idiosyncratic use of behaviour observation to inform the design of public space was developed by landscape architect Lawrence Halprin in the 1960s, drawing on inspiration from his wife Anna Halprin, an avant-garde dance choreographer. The method for researching and developing environments, termed the RSVP cycle, (Resources, Scores, Valuation and Performance; Halprin, 1969), conceived of *Resources* as including the human and physical

environment and people's motivations, *Scores* that directed action (a park or street design might be one such score), *Valuaction*, emphasizing analysis of the action that might result, and *Performance* being the human behaviour and other processes arising from the score (see Figure 3). While the method's arcane terminology is unlikely to be used in current research, the overarching notion of designed environments leading to a choreography of behaviour is one that resonates with the idea of affordances as well as to ethnographic approaches to understanding human activity. In practice, Halprin's studies of human behaviour in natural environments such as wilderness streams led to some radical and highly successful urban plaza designs – notably the Lovejoy Fountain Park and Ira Keller Fountain in Portland, Oregon – that have afforded adults as well as children an active and playful engagement with water to a degree rarely seen in public plazas before or since (City of Portland. 2011; Halprin Landscape Conservancy, 2011).

(Figure 3 about here)

Such work, whether Halprin's approach, or more conventional behaviour observation, relies on the identification of existing or potential behaviour settings; meticulous protocols for observing, recording and mapping behaviour patterns over time, linked to the environments that afford them; and careful analysis of the physical attributes of places where they occur. Proponents of the method are frequently urban and landscape planners and designers, partly because behaviour mapping is recognized as a graphic tool that resonates with their method of practice (Southwell, 2004). Examples include studies by Gehl and Gemzøe in Copenhagen (1996), Whyte in New York City (1980), Moore and Cosco in North Carolina and Goličnik in Ljubljana and Edinburgh (Goličnik, 2005). Gehl and colleagues' work has been particularly important in using longitudinal studies between 1985 and 2005, based on behaviour observation,

to demonstrate the effect of changes to the built environment to encourage greater activity and outdoor use. (Gehl & Gemzøe, 1996, Gehl, Gemzøe, Kirknæs, & Søndergaard, 2006).

4.2. GIS based approaches to affordance

Kyttä (2002, 2004) has applied the concept of affordance while working at a neighbourhood planning scale and using Geographic Information Systems (GIS) mapping tools, to understand how varying layouts of neighbourhoods offer different kinds and numbers of affordances. She worked initially through interviews with children in different communities in Finland and Belarus, to explore opportunities within their home and habitual range for a variety of activities such as cycling, running, skipping, swimming, hiding, or making structures. Building on Heft's (1988) functional taxonomy of children's outdoor environments, she added a category of social affordances, such as opportunities for role-playing or for sharing adults' business. She also distinguished between potential affordances (where the opportunity for activity could not be taken up because of some kind of restriction), utilised affordances (opportunities that exist and can be taken up) and shaped affordances (opportunities created through modifying action by the child or children themselves).

Kyttä has developed and refined this method with a wider range of participants and contexts, using the mapping of affordances to identify relevant aspects of environmental quality for different people's activities within a town or neighbourhood. She developed a GIS-based method, 'softGIS', administered via the internet, and designed to be easy to use in gathering map-based information on affordances for all age groups, from school children to older adults (Kyttä, 2011). Such an approach produces findings that can readily be related to other GIS-based data, such as objectively measured elements of the physical environment, as well as to health survey data on levels of physical activity (Kyttä & Kahila, 2011). For example, parameters such

as building density, the proportion of green space, permeability of the urban structure (how easy it is to get from any one point to any other, especially for pedestrians) and land use diversity can be developed in relation to the area around each respondent's home, or for the neighbourhood as a whole, and then analysed for relationships with the levels and kinds of affordances offered.

Such an approach is attractive to planners in facilitating analysis of physical urban form in relation to perceived opportunities for different activities (Kytta & Kahila, 2011) and thereby to support for active lifestyles.

4.3. Objective measures of environment and activity

The increasing amount of data available in GIS form, or readily transferable to GIS, has greatly enhanced opportunities for spatial analysis of different patterns of health and activity in relation to environmental qualities. Many such approaches have used environmental audits to capture and map physical attributes of the environment such as pavement width, street trees or controlled pedestrian road crossings, as well as GIS-generated data such as street connectivity and land use diversity, to characterise the outdoor environment around where people live (Boarnet, Day, Alfonzo, Forsyth, & Oakes, 2006; Brownson, Hoehner, Brennan, Cook, Elliott, & McMullen, 2004; Frank, Schmid, Sallis, Chapman, & Saelens., 2005; Millington et al., 2009; Pikora et al., 2002). Such data have then been analysed for relationships with health and physical activity levels, especially walking levels (Frank et al., 2005; Owen et al., 2004; Sallis, 2009; Transportation Research Board, 2005). The burgeoning health literature relating aspects of the environment to physical activity is a reflection of the attractiveness of this approach to those responsible for public health policy. However, much of the work, especially in the earlier studies, has relied on very time-consuming gathering of data (such as environmental audits in the field) and on self-report measures of activity with varying levels of accuracy and comparability

that frequently over-estimate actual levels of exercise (Bauman, Phongsaven, Schoeppe, & Owen, 2006; Bull et al., 2010).

Recent innovations in technology have made an enormous difference to the range of options open to researchers interested in physical activity and the environment. Changes in the robustness, size and affordability of pedometers and accelerometers for measuring step counts and levels of activity, from sedentary to moderate or vigorous exercise, have made objective measurement of activity levels a realistic proposition on a scale unthinkable a decade ago (Frank et al., 2005; Welk, 2002;). Similarly, the use of lightweight and comparatively low cost global positioning system (GPS) tracking devices has recently allowed objective mapping of people's whereabouts in the outdoor environment in greater numbers and at a more detailed level than ever before. GPS derived maps, often based on aerial photographs, combined with GIS techniques, allow people's movements to be mapped and related to different physical attributes of their environment, without the need for direct observation or detailed recording on site (see, for example, Mackett, Brown, Gong, Kitazawa, & Paskins, 2007).

These techniques are undoubtedly a valuable advance, especially in terms of understanding relationships between people's perceptions and self-reported activities and the actual level of exercise achieved in different kinds of places. However, such methods, used on their own, remain unable to explain the psychology behind people's behaviour or their perceptions of the environment and what it offers. Further, there is evidence that people's perceptions of an environment are, in some contexts, a better predictor of physical activity levels than many objective measures, (Ball et al., 2008; Gebel, Bauman, & Owen, 2009). For this reason, there continues to be an interest in methods that increase our understanding of people's perceptions, attitudes and beliefs in relation to their environment and in mixed method

approaches that combine objective and subjective measures, in order to research links between environment and physical activity.

4.4. Personal Projects

An approach that has been used to help understand why a given environment elicits a certain response in terms of activity for one individual and not another is ‘personal projects’ analysis (Little, 1983). Personal projects refer to a set of goal-oriented, self-generated activities a person is doing or thinking of doing: “extended sets of personally salient action in context” (Little, 2010, p. 166). Unlike behaviour settings, here the unit of analysis is the project, which is a behaviour embedded in an environmental context (Little, 2000). This approach has resonance with Lynch’s writings about how good design should support behaviour and open up possibilities: “One needs to know both what people *do* and also what they experience and plan” (Lynch, 1971, p. 37). The analytical methods of personal projects draw on Kelly’s (1955) personal construct theory, while taking into account people’s individual traits, wants and needs. Since a major challenge in examining the role of the environment in relation to people’s activity lies in identifying the *relevant* quality of the environment, a personal projects approach responds to the diversity of people’s lifestyles and activity patterns by recognising that salient environmental attributes and settings vary between them. Little (2010) has identified five major dimensions that are the key to understanding personal projects: project meaning, manageability, support and community, positive affect and negative affect.

Analysis of the physical environment in relation to personal projects uses the concept of environmental support (described earlier) to understand how idiosyncratic needs may be frustrated or enabled by the environment necessary to pursue a particular project (Sugiyama & Ward Thompson, 2007a, 2007b). For example, the kind of environment needed to support

playing with one's grandchildren, or practising golf putting, is quite different from that needed for walking to the local school to act as a road crossing warden (Ward Thompson, 2010a), while the quality of the sidewalk outside an older person's home may be relevant to all of these projects, and make some pleasant or, conversely, impossible. Personal projects analysis builds on ideas of environmental fit but emphasises individual differences through planned and desired activities - projects - that seems particularly apposite for studying how the design of the environment elicits different kinds and levels of physical activity.

4.5. Conjoint analysis

The final method highlighted here is one that has only very recently been used to explore the comparative importance of different environmental features in relation to preference for one environment over another for different uses. Conjoint analysis was developed in response to the observation that a person's preference for an object or a place cannot be determined reliably simply by recording and combining their ratings of its various, separate components (Aspinall, 2010). Instead, conjoint analysis uses people's overall evaluations of an object or place and, by comparing such evaluations across a varying set of objects or places, derives ratings for individual components from this holistic starting point. It is a discrete choice methodology that has proved very effective in examining attributes of marketable products to predict consumer behaviour. The evidence suggests it is more accurate than conventional methods in making such predictions (Orme, 1998). Choice-based conjoint analysis (Orme, 2005) has been used in UK research to explore the relative importance of different attributes of a neighbourhood park in determining older adults' preference for one park over another (Aspinall, 2010). The value of this kind of analysis lies in demonstrating a direct and meaningful comparison of the relative importance of different attractors (such as plentiful trees or a well-maintained park with many

benches) and detractors (such as vandalism, dogs and dog fouling, or heavy traffic *en route* to a park), so that an intervention with the greatest effectiveness or ‘utility’ can be identified. Such evidence relates directly to the needs of environmental planners, designers and managers, offering a way to prioritise limited resources so that the environment can be made most attractive for use by different groups of people, or for a particularly targeted group. Such methods point the way to the different kinds of evidence that can be generated to inform design of the outdoor environment for enhancing active use at different scales of analysis. The final section of this paper reviews findings of particular relevance to planners and designers, demonstrating how the theories and methods outlined above contribute in different ways. The findings start with a consideration of the neighbourhood planning scale and then move to more detailed consideration of individual streets, parks and natural spaces and playgrounds.

5. Neighbourhood Planning and Design

5.1. The comparative importance of physical environment

Before considering evidence on aspects of the neighbourhood environment that support greater levels of physical activity, it is appropriate to return briefly to the social-ecological model described earlier (See Figure 1). Some researchers have attempted to ascertain the relative importance of different levels of the model in influencing people’s behaviour, particularly their physical activity levels. Such information would be of relevance to health professionals wishing to use interventions to change people’s behaviour so that they become more active. Researchers have tried to ascertain how much in active behaviour patterns is down to individual characteristics and preferences, how much is explained by socio-economic, political, and cultural factors, and how much is explained by the qualities of the physical environment.

An early study of physical activity in Perth, Australia (Giles-Corti & Donovan, 2002),

using a questionnaire based on a social-ecological model, found that the availability of an attractive neighbourhood environment (places such as streets, public open space and the beach) was significant but secondary to individual factors (such as perceived ability to stick to self-set goals) and social environmental factors (such as having a companion with whom to do activities). In this study, individual factors far outweighed those of the social or physical environment. A similar study by De Bourdeaudhuij and colleagues (2005) confirmed the importance of psychosocial factors, which explained considerably more of the variance in physical activity (42%) than urban landscape features (10%).

Although such studies point to the importance of factors other than physical environment in explaining or influencing people's activity levels, they nonetheless highlight a recurrent finding: that the physical environment *is* significant. Indeed Rhodes et al. (2006) suggest that the environment may play an important role in psychosocial factors, including moderation of individual intentions to be active (influencing the 'intention-behaviour gap'). Based on this premise, what follows focuses on findings related to the physical environment but must be read within a context of the broader ecological models described earlier in this paper.

Interest in neighbourhood environmental attributes associated with physical activity levels have focused on two aspects of the outdoor environment in particular: (1) 'walkability' and street or neighbourhood characteristics that are associated with comparatively high levels of walking and associated activity (running, cycling, etc.) (e.g., Leslie, Saelens, Frank, Owen, Bauman, Coffee et al., 2005; Rhodes et al., 2007; Saelens et al., 2003) and (2) the influence of green or natural spaces on health more generally, including physical activity (Bedimo-Rung, Mowen, & Cohen, 2005; Croucher, Myers, & Bretherton, 2007; Ellaway, Macintyre, &

Bonnefoy, 2005; Mitchell & Popham, 2007, 2008; Ward Thompson, 2010a). Each are considered in turn, below.

5.2. Neighbourhood walkability

In considering walkability, the work of the Robert Wood Johnson Foundation's Active Living Research Program since 2001 (Orleans et al., 2009) has had a considerable impact, especially in the North American context. A key issue highlighted early in this burgeoning research area was the difference between walking for recreation and walking for transport, or utilitarian walking (Sallis & Owen, 2002). Saelens and Handy (2008), in an overview of 13 previous reviews and 29 original studies, identified building density, distance to nonresidential destinations (such as local shops and services), and land use mix as consistently associated with utilitarian walking, with some, more equivocal, associations for route/network connectivity, parks and open space, and personal safety. Results regarding recreational walking were less clear. Sallis and colleagues' (2009) comparison of environmental attributes and physical activity in 11 different countries - Belgium, Brazil, Canada, Colombia, China (Hong Kong), Japan, Lithuania, New Zealand, Norway, Sweden, and the U.S. – found 5 perceived attributes of neighbourhood environments associated with respondents achieving recommended levels of physical activity. Those 5 attributes were: many shops nearby; a transit stop in the neighbourhood; sidewalks on most streets; bicycle facilities; and low-cost recreational facilities. The purpose of walking or other physical activity was not distinguished in this meta-analysis, but the most significant factor was having sidewalks on most streets, emphasizing the utilitarian importance of this attribute. The associations with shops, transit facilities (and possibly cycling) also suggest their connection to utilitarian activities or functionality.

Nonetheless, links between environmental attributes and walking for recreation have

been shown in other research. In research on attributes of neighbourhood open space and older people's activity, for example, Sugiyama and Ward Thompson (2008) found that pleasantness of open space and lack of nuisance were associated with walking for recreation, while good paths to reach open space and good facilities in open space were more associated with walking for transport. Attractiveness of parks and open space has been shown to be associated with walking for recreation in several studies (Bedimo-Rung et al., 2005; Rhodes et al., 2006) and may indeed be the most important characteristic for some groups (Sugiyama, Francis, Middleton, Owen, & Giles-Corti, 2010). This finding contrasts with Borst and colleagues' (Borst et al., 2009) work with older people on utilitarian walking routes, where green strips (i.e. areas of vegetation between pavements and streets) and parks (open space) were seen as inhibitors rather than supporters of walking, as were changes in level, litter on the streets and 'blind' or windowless walls facing the streets. Borst et al. (2009) confirmed the importance to utilitarian walking of good pavements, as well as front gardens, dwellings on the first floor, or shops along them, and low traffic volume. These findings suggest that convenience and speed of pedestrian movement, along with feelings of safety, are what is wanted in terms of environmental support for utilitarian walking. Walking for recreation, by contrast, seems to be much more linked to the aesthetic quality of the experience, where natural environments and open space become an attractor (Giles-Corti et al., 2005; Sugiyama et al., 2010).

Another key area of interest is children's levels of activity. Environmental support, or lack of it, for children's active travel (walking or cycling) and play has received a great deal of attention recently as concern over children's constrained environments, obesity and declining levels of physical activity and poverty of real world experience have been articulated (e.g., Cooper, 2005; Gill, 2007; Louv, 2005).

5.3. Neighbourhoods that support children's activity

Consideration of environments for children's activity relates to support for children's overall developmental health as well as for activity that maintains health. The focus here is restricted to the relationships between planning and design of the outdoor environment and children's activity levels, recognising that there are many facets of importance in environmental design for children that are not covered. A key element of interest, however, is the simple fact that children are more active outdoors than indoors (Ferreira et al., 2007; Sallis, Prochaska, & Taylor, 2000), and therefore the freedom with which children can access and use outdoor places in their local environment is likely to be a key component in environmental support for physical activity.

Using interviews with 8-9-year-old children in Finland and Belarus to explore opportunities within their home and habitual range for a variety of activities, Kytta found that the lowest number of affordances utilized in both study areas were in the city environment. The highest levels were in the Finnish rural village, perhaps because of the rich opportunities that the natural environment offers. While the relationships between urbanisation and affordances were more complex in Belarus, one inference is that city environments offer a more limited range of environmental opportunities for children's activity than suburban, small town or rural environments (Kytta, 2002).

Kytta subsequently demonstrated that the Finnish communities offered a very positive environment for children's active development by creating a virtuous circle (a complex of events that reinforces itself through a feedback loop, with favourable results). Children here had a high degree of independent mobility by comparison with Belarus and therefore were more likely to utilise affordances in the neighbourhood, with these 'actualised' affordances in turn motivating

children to be more mobile (Kytä, 2004). In both the Finnish and Belarussian study communities, the percentage of highly child-friendly environments of this type decreased as the degree of urbanization increased.

Mackett's English study of activity levels for children aged 8-11 in Hertfordshire suburban communities, using GPS monitors and accelerometers, confirmed that a key factor in children's overall activity levels was how free they were to go out without an adult (Mackett et al., 2007). Boys were given more freedom than girls in this respect, but both were more likely to be allowed out alone if they lived near a local park, suggesting that good local park provision may increase children's levels of physical activity simply by making it possible for them to go out alone and therefore more often (Mackett, 2007).

5.4. Access to parks and natural open space in the neighbourhood

Recognising the attractiveness of public open space for walking, Giles-Corti and colleagues have had a growing interest in the relative importance of different attributes of open space, including its location and suitability for certain activities (Giles-Corti et al., 2005; Sugiyama et al., 2010). Sugiyama and colleagues' (2010) Australian study of attractiveness, size and proximity of neighbourhood open spaces in relation to adults' recreational walking found that the distance to an attractive park predicted whether or not people undertook any recreational walking at all. However, when considering *how much* walking people undertook, and in particular whether they achieved recommended healthy levels of walking (150 minutes or more per week), the study found that the closeness of a park was less critical than whether or not a large, high-quality park was available at all within walking distance (defined as within 1.6 km). The authors speculate that the size of larger parks may offer opportunities for physical activity that are absent in smaller open spaces, offering more facilities or a greater variety of activities as

well as, perhaps, providing a more attractive environment. However, they also note that the importance of proximity to open space may be different in this (mostly young to middle-aged) sample of adults compared with that for children and their caregivers, as well as for older people.

Given such evidence, as well as findings from a cross-European study showing that the quality of the landscape appears to influence physical activity (Ellaway et al., 2005), there has been growing research interest in whether physical exercise undertaken in natural or ‘green’ environments is more effective than in other environments. Is this kind of exercise more likely to benefit mental as well as physical wellbeing, or more likely to encourage people to maintain behaviour change towards greater activity outdoors (Barton & Pretty, 2010; Bowler et al., 2010; Pretty et al., 2007; Sugiyama et al., 2010)? Bowler et al. (2010) conclude that there is some evidence of physical activity in a natural environment having a more positive effect on emotions than in a ‘synthetic’ environment but less evidence for any ‘added value’ of exposure to a natural environment on physiological outcomes. It is known that physical activity can enhance mood and alleviate depression (Rethorst, Wipfli, & Landers, 2009), but the question arises: does the role of the natural environment lie in encouraging physical activity, which in turn promotes mental wellbeing, or is it the case that people seek an environment that makes them feel good psychologically and then find it more attractive to walk or be active in such settings?

The evidence on relationships between environmental design and health, particularly in relation to accessing green and natural spaces, is complex; and studies to date point to a stronger relationship between natural environments and mental health than with physical activity (de Vries, 2010). De Vries’s wide-ranging review of empirical studies for links between ‘nearby nature and health’ explored explanatory mechanisms relating to: reducing the ill-effects of pollution on respiratory health (through improved air quality); reducing stress and offering

restoration; stimulating physical activity; and facilitating social contacts and cohesion. The review concluded that stress reduction and support for social cohesion are more likely to explain the relationship between the availability of green space in a residential neighbourhood and its inhabitants' health than enhanced air quality or enhanced physical activity. It may be, therefore, that any contribution that an attractive outdoor environment makes to eliciting or supporting physical activity is largely indirect. In other words, making a place attractive for stress relief or mental wellbeing, in turn may encourage people to walk there more often or for longer (Bowler et al., 2010; Kazcynski & Henderson, 2007). Equally, an attractive physical environment that makes a place appealing for social contact, meeting people or doing things together, may support physical activity as an incidental benefit (O'Brien & Morris, 2009; Sugiyama & Ward Thompson, 2007b).

Goličnik's (2005) study of urban parks in Ljubljana and Edinburgh using behaviour observation has identified behaviour settings and regular activities, such as informal football or Frisbee games, that take place in predictable ways within readily accessible green open space. For example, informal football (often short-lived) was most common in groups of between 5 and 15 people and used an area of 1,000 – 3,000 square metres, but needed a buffer zone of between 15-30 metres from a park edge next to a road, a buffer of 8-20 metres from other park edges, and a buffer of approximately 20m between groups of people (Goličnik & Ward Thompson, 2010). Although this was an exploratory study, it illustrates how this kind of detailed analysis can inform green space design to encourage active use, and use by different groups within the same space. It also points to potential reasons why lack of access to appropriate open spaces may contribute to health inequalities.

5.5. Equity of access to green and natural spaces

A considerable body of evidence, particularly from North America and the UK, indicates that the distribution and quality of green and open space varies across the socio-economic gradient. In many cases, low income groups and/or black and minority ethnic groups have poorer access to public parks and outdoor facilities than other groups (Abercrombie et al., 2008; Comber, Brunsdon, & Green, 2008; Kuo, 2001; Heynen, Perkins, & Roy, 2006; McIntyre et al., 2008). Also, the quality of local open space can be poorer (Gobster & Westphal, 2003; Macintyre et al., 2008). Often such deprived groups suffer from a combination of these inequalities in provision. At a neighbourhood planning scale, these differences mean unequal opportunity for outdoor activity; what is less clear is the degree to which this impacts on different groups' actual levels of physical activity.

More research is still needed here, especially in the UK, where it is only comparatively recently that the different perceptions and needs of diverse black and minority ethnic groups for local open space and healthy activity have been explored in a robust way (CABE, 2010; Rishbeth, 2004). In a US study of white (non-Hispanic), African-American (black, non-Hispanic), and Hispanic communities, each of three different income levels, Floyd, Spengler, Maddock and Gobster (2008) have shown differences in park-based physical activity according to neighbourhood income and racial/ethnic composition. Park-based physical activity was lowest in low-income Hispanic neighbourhoods, and highest in high-income African-American neighbourhoods. However, there was also an association between physical activity and facilities (e.g., presence of tennis courts, basketball courts or soccer fields) which suggested that the specific physical features of the park were as important to levels of physical activity as income or racial/ethnic group. The authors state: "the study provides quantitative evidence of how various activity areas within parks facilitate and constrain physical activity" (Floyd et al., p. 304) and

argue for research to better understand how specific, culturally salient configurations of facilities can enhance moderate and vigorous physical activity in parks.

5.6. Gender and design of public parks to support activity

Krenichyn's (2004, 2006) qualitative study of women's experience of physical activity (often running, cycling or skating rather than walking) in Prospect Park, New York City, illustrates some of the issues relevant to understanding gender differences in what constitutes a supportive environment. Krenichyn examined ways that the outdoor environment might encourage and enhance, or discourage and detract from, physical activity of women in this large, urban park. Her findings supported earlier work on women's health (e.g., Eyler et al., 2002; Wilbur, Chandler, Dancy, Choi, & Plonczynski, 2002) showing that exercise was more enjoyable and meaningful in the park compared to in the street because of the beautiful scenery and the therapeutic or spiritual experience associated with the park's aesthetic qualities. Practical features, such as provision of water fountains and toilets, were also an attraction for some. Deterrents to physical exercise commonly experienced when participants exercised in street environments included feeling unsafe from traffic and harassment in the form of catcalls and male comments. By contrast, the park afforded a traffic-free environment where women felt freer to dress comfortably and generally less susceptible to unwelcome remarks. Overall, the park allowed many to incorporate outdoor exercise into their daily routine because of its proximity to where they lived and "to actualize a desire to be outdoors and to find a sense of enjoyment that other places did not always afford" (Krenichyn, 2006, p. 637). However, qualities that contributed to feelings of fear or safety from interpersonal crime were more complex, with the enclosure experienced in heavily wooded areas a detractor for some, despite the general aesthetic attraction of the natural environment. Similarly, the presence of unleashed dogs has been

identified as a serious detractor for some women, especially for certain ethnic groups (Eyler et al., 2002; Wilbur et al., 2002), while for others the opportunity to give their pet freedom to exercise is clearly an attractor.

This kind of in-depth study illustrates the complexities in understanding how design and management of public open space can facilitate or frustrate attempts to walk or cycle more. In a multilevel study of different factors as determinants of walking levels, Ball et al. (2007) found that environmental features (including aesthetics and safety factors) were important for walking. Women living in a coastal neighbourhood, for example, were 46% more likely than women living in other contexts to walk during leisure time and nearly three times more likely to walk for transport. However, they found that cognitive factors (self-efficacy, enjoyment and behavioural intentions) remained the strongest predictors of leisure time and transport-related walking. Such studies suggest that the relative contribution of individual, social and environmental factors are likely to differ for different behaviours and for sub-groups within the population. They also underline the importance of the social context as well as the physical, and this remains true when examining the built environment – the paved streets and squares of urban life.

6. Design of streets and squares to support activity

Jan Gehl's early work in Copenhagen took advantage of a pedestrianization scheme for a city centre street to research what makes a 'walkable' environment through behaviour observation (Gehl & Gemzøe, 1996). This led to a wider interest in 'life between buildings' (Gehl 1987), the attributes of the street and open space environment that afford more flexible and enjoyable use, and a replication of the approach to other cities, such as Melbourne and London (see Gehl, 2007 for a summary). Gehl's work has not focused principally on physical activity *per se*; rather, he has been particularly interested in the details of affordances, such as bollards (i.e.,

short posts) that can be perched on, or steps that can be used as seats, which encourage people to stop and linger in public open space rather than simply keep moving through them. He has concluded that a key attribute for better and more sociable use of streets and squares is the number of opportunities for seating (a finding supported by Whyte, 1980), including seating in sun or shade, with options for shelter from the wind, and flexible seating such as offered by outdoor cafes, as well as the informal affordances mentioned earlier – steps, ledges, bollards, etc. that offer a place to rest (Gehl, 1987). While those seated are evidently not engaged in physical activity, they provide a social ambience and informal surveillance for those passing by, and seats and cafes offer attractive destinations or rest stops for walkers. Despite a primary focus on lingering rather than being physically active, Gehl's work has produced a number of behaviour observation studies, many of them repeated, longitudinal surveys (e.g., City of Melbourne and GEHL Architects, 2004; Gehl & Gemzøe, 1996; Gehl et al., 2006), that provide evidence for what makes a street or square likely to be well-used. Such streets and routes are likely to feel safer and be more pleasant for walkers than alternatives that offer few opportunities for 'street life'.

The detailed attributes of the urban environment identified by Gehl (1987) that make walking more comfortable are: width of pavement; smoothness of walking surface; directness of routes offered; variety and attractiveness of views along the route; low levels of vehicular traffic; ease of street crossings and absence of steps on the main walking route. Paying attention to these attributes as part of GEHL architects' recommendations for the city centre of Melbourne was reflected in a weekday increase in observed summer pedestrian traffic of 39% during working hours and 98% for evenings, between 1993 and 2003 (City of Melbourne and GEHL architects, 2004). However, part of this increase was no doubt also due to making public space in the city

centre more attractive for lingering: the number of seats offered by kerbside cafes in Melbourne increased by 177% between 1993 and 2003.

Approaches based on more active options for use of streets and squares, above and beyond walking or cycling, include attention to what makes for playful spaces, for adults as well as children. Halprin (1969) used his RSVP method and associated behaviour observation to inform the design of interactive, 'playable' civic fountains in Portland Oregon in the 1970s, where Lovejoy Fountain Park and Ira Keller Fountain are well-used for a range of active engagements with water (Halprin Landscape Conservancy, 2011). The more recent proliferation of fountains that arise directly from paved surfaces and with variable, often unpredictable, patterns of flow (found in Fountain Place, downtown Dallas, in Crown Center Square, Kansas City, in Parc André Citroën, Paris, and in Thames Barrier Park, London, to name but four) is a reflection of the attraction that water has for playful activity. In warm seasons, these are especially enticing, principally (but not only) for children's active use and, compared with Halprin's designs, take an approach that is more straightforward for regulation in terms of health and safety (see Figure 4).

(Figure 4 about here)

Another active use for streets and squares is skateboarding, along with similar wheeled sports such as roller-blading or roller skating, and more extreme sports such as parkour, which involves people moving through their environment by vaulting, rolling, running, climbing and jumping, rather than simply walking. While this last, highly energetic approach, is very much a minority sport and one that needs no special environmental attributes, activities such as skateboarding have received mixed support from environmental designers. On the one hand, skateboarding in the everyday street environment, rather than in specialist facilities in

playgrounds, has become something of a cult activity with an enthusiastic youth following (Borden, 2001); on the other hand, many designers and managers disapprove of the activity, and it may be a deterrent to others' feelings of safety or comfort (Woolley & Johns, 2001). In one of the few, systematic studies of skateboarding using behavior observation, Goličnik (2005) identified the details of length of run necessary for a useable skateboarding edge or change in level, and the space needed for preparing and recovering from a trick performed along such an edge. She also observed and mapped, within public squares, how skateboarders behaved in relation to other users and avoided confrontations. Such details can provide a better basis for designing active environments that include skateboarding within the general public realm.

Within more residential street environments, Gehl (1987) has called for 'soft edges' to animate the street and attract social use, based on studies in Canada, Australia and Denmark. The key elements he identified are easy access in and out of buildings, good places to rest, and good opportunities for 'something to do' in front of houses or buildings. Examples of places that provide such elements are porches or verandahs and semi-public front yards or gardens that offer good visual access between the home environment and the public street. As identified earlier, more sociable use of street edges offers 'eyes on the street' that can add to feelings of safety for passers-by.

The findings and recommendations outlined in this section so far, coming largely from behaviour observation, reinforce more recent evidence on walkability, such as that by Borst et al. (2009; see *Neighbourhood Walkability*, above), that show the importance not only of good pavements but also of front gardens and shops or dwellings along the street, providing attractive, sociable environments that also appear safe to use.

Reduction in motorised traffic levels and speeds also enhances pedestrian and cyclist use of streets. For example, Morrison, Thomson and Petticrew (2004) showed that introduction of speed humps on a main road bisecting a deprived housing estate in the UK resulted in increased self-report walking and observed pedestrian counts. Recent attempts to introduce street designs where traffic speeds are constrained to below 15 or 20 mph, and pedestrians and cyclists are given equal priority to motorized vehicles, have offered opportunities to study whether more radical environmental designs (called Home Zones, after the Dutch ‘Woonerf’ which inspired them (see <http://www.homezones.org/concept>)) can encourage more active use of the space. A study of seven pilot schemes in the UK looked at the impact on walking and cycling of Home Zone interventions that included gateways, signs and repaving to indicate shared space streets, traffic calming elements such as road narrowing and chicanes, tree and shrub planting, and street artworks, showed little change in levels of active street use (Webster, Tilly, Wheeler, Nicholls, & Buttriss, 2006). Self-report levels of walking to the local shops remained almost identical after the intervention to that before, although 44% thought the walk more pleasant, and cycling levels stayed the same although 30% thought cycling more pleasant after the interventions. Effects on children’s biking were again, not significant. Although these results are based on self-report rather than objective measures of activity, they suggest that we need more evidence to understand how to enhance active use of residential streets through modifications to the road environment, as well as a better understanding of the wider context in which such modifications are experienced and responded to.

Also of relevance is the way that different age groups respond to environments and environmental change. As discussed in the earlier, theoretical section on environmental support for physical activity, the environment can become a limiting factor on people’s mobility as their

functional capabilities change in old age (Iwarsson, 2005). It is relevant therefore to consider evidence on support for older adults' activity in more detail here.

7. Older people's outdoor activity

Research on environmental correlates of older people's outdoor activity (e.g., Borst et al., 2009; Sugiyama & Ward Thompson, 2008) suggest that many of the variables important overall for older people's walking are also important for the adult population more generally. Sugiyama and Ward Thompson (2008), working with people aged 65 or over in the UK, found pleasantness of open space and lack of nuisance to be associated with walking for recreation, while good paths *en route* and good facilities in open space were more associated with utilitarian walking. Borst and colleagues' work in The Netherlands (2009), on utilitarian walking routes only and for an age group starting at 55 years, found parks and green strips (areas of vegetation between pavements and streets) were seen as inhibitors of walking, as were changes in level, litter on the streets and 'blind' or windowless walls facing the streets, while good pavements, front gardens, dwellings on the first floor, or shops along them, and low traffic volume supported walking.

What is of particular interest is how these variables may change in priority or weighting as people move into different life stages or states of health and mobility. Use of choice-based conjoint analysis (a discrete choice method, described earlier) has indicated how the comparative importance of different features of the environment can be assessed in determining older people's preference for one park or open space over another (Aspinall, 2010). The study, based on a diverse UK sample of people aged 60 or over, showed that the most important attributes overall in determining preference were: nuisance levels (signs of vandalism, dog fouling or youngsters hanging around), facilities (toilets or a café), the amount of trees and plants, vehicular traffic levels *en route*, things to watch in the park, and levels of park maintenance (Aspinall et

al., 2010).

The value of this kind of approach lies in demonstrating a direct and meaningful comparison of the relative importance of different attractors (such as plentiful trees) and detractors (such as vandalism), so that an intervention with the greatest effectiveness or ‘utility’ can be identified. For example, provision of toilets within a park formerly lacking them had greater utility than removal of social nuisance such as undesirable youngsters hanging around. However, while heavy traffic was considered an important deterrent to getting to the park, restricting the traffic to a medium or light flow had less utility than removing signs of vandalism in the park (Alves et al., 2008; Aspinall et al., 2010).

One key contribution of this kind of analysis is the opportunity to model ‘what if’ scenarios, so that the effect of environmental changes on people’s choice can be simulated and comparative trade-offs of change to different elements can be assessed in terms of people’s preferences (Aspinall et al., 2010). Another contribution is that it allows identification of subgroups within the sample population for whom different priorities are important, a vital element in understanding how environmental interventions might have differential impact on outdoor activity for different groups. In this study, while natural elements and the aesthetic experience of trees and plants were important for all groups, the relative importance of distance to a park, and of attractive trees and plants *en route* and in the park, was greater for participants living alone than for those who live with someone else. For the latter group, provision of facilities and a car park was of greater importance than for the first group. For older people with some mobility impairment, the provision of seats *en route* and within the park was more important than for other people (Aspinall et al., 2010).

Such findings suggest that affordance studies with older participants are likely to yield

useful results. For older people who have some level of mobility impairment or who have low levels of stamina, for example, environments that offer frequent opportunities for sitting, perching or leaning against some kind of support become very important, whatever their formally designated function. Similarly, somewhere at the right level on which to put a bag down while looking for a purse or keys, for example, may become important. In the absence of benches, places such as window ledges, bollards, railings, low walls, etc. may all become vital components of such affordances in the landscape. Conversely, lack of these kinds of affordances may mean that older people decide not to go out at all, or limit their outdoor activity. Qualitative studies using behaviour observation have started to map these kinds of affordances (e.g., Southwell, 2007), but more work is needed to understand fully how the environment can best support older people's physical activity.

8. Children's environments and physical activity

Consideration of social and environmental support, or lack of it, for children's play is a subject that has received a great deal of attention recently, as concern over constraints on children's freedom to play outdoors, declining levels of physical activity and poverty of real world experience have been articulated (e.g., Cooper, 2005; Gill, 2007; Louv, 2005). Kytta's work (2002, 2004) on environmental support for children's activities at the neighbourhood planning scale, based on affordances, has been described earlier. Drawing on principles of affordance at a more detailed level, Moore and Cosco have undertaken a programme of research over a number of years to understand how design for play can support different kinds and levels of activity in children (Moore, 1986; Moore & Cosco, 2007). Using behaviour settings as the unit of analysis within each location, they have studied children's playgrounds in pre-school daycare centre, school, neighbourhood park and museum contexts. Their systematic recording of levels

of use and sedentary versus active behaviour in different settings within the playgrounds offer valuable insights into what makes for successful and well-used play areas. For example, generous pathways linking different elements and areas within a neighbourhood playground supported easy and active use by children and their carers (Moore & Cosco, 2007). Although settings that offer manipulable components or loose parts (e.g., sand or gravel pits) are particularly attractive to younger children, as evidenced in a children's museum setting, a study of preschool children using accelerometers to record levels of activity showed that open areas and pathways were important for higher levels of moderate to vigorous physical activity (Moore & Cosco, 2010). These studies suggest that setting diversity, materials and spatial layout can be combined by design to create play environments for different age groups that encourage a positive level of physical activity, and that layout in particular is a key attribute of affordance for being active.

Work on environmental support for physical activity with children in their teenage years has proved a more complex matter, with reviews such as those by Sallis et al. (2000) and Ferreira et al. (2007), suggesting that, for adolescents at least, few if any significant relationships could be established between physical features of the built environment and physical activity. Still, there is some evidence that the availability and accessibility of physical activity facilities or programmes for adolescents may make a difference (Sallis et al., 2000). The systematic review by Ferreira et al. (2007) found that crime incidence, as measured through objective police reports, was inversely associated with adolescents' activity levels, despite the finding that perceived neighbourhood safety levels were not associated with adolescents' activity levels. This apparent contradiction points to a likely difference in what is being measured when using subjective rather than objective characteristics of the environment, and the need to consider both

when studying influences on physical activity. Qualitative research in the UK has highlighted the importance of the social environment for teenagers (Travlou, 2007) and the difficulty of eliciting meaningful information about the influence of physical environments in an age group where the social has such an overwhelming importance for most young people (Ward Thompson, 2007).

Despite the absence of quantitative evidence on the influence of environment on adolescent physical activity levels, it seems likely that the physical environment plays some role in eliciting or inhibiting activity. Focus group research in the UK has suggested that there is a great attraction in risky and adventurous activity, especially for adolescent boys, in environments that offer challenge within an accessible context (Natural England, 2010). This research underlines the importance of social context as a determinant of accessibility for many deprived young people, which may be as much about gang or group territories as physical attributes of the environment.

Beyond childhood, there is growing interest in the influence of childhood experience on physical activity in adulthood. Exploratory research on a life histories approach to understanding preference and use of the outdoors (Uzzell, Gatersleben, & White, 2010) illustrates how positive childhood experience of being active in outdoor and natural environments appears to be associated with active use of outdoor environments as an adult and, conversely, how limited or negative childhood experience of the outdoors may limit adult use. This research supports indications from other studies that changes in levels of active outdoor use occur at different life stages. Even though most participants in the study had frequent, energetic use of outdoor places in childhood, they used the outdoors in this way much less as they moved into adolescence and young adulthood, returning to more active use in mature adulthood, particularly in the context of having their own children. Such qualitative studies reinforce the findings from Ward Thompson,

Aspinall and Montarzino (2008), which demonstrated how frequency of childhood use of green space or natural environments such as parks and woodlands predicted adult frequency of use. In different UK contexts, it was seen that infrequent green space use in childhood was very strongly associated with low levels of use in adulthood. This finding suggests that attempts at environmental intervention to encourage or support greater levels of physical activity in a community need to focus on ease of access to outdoor spaces for children. Moreover, it suggests that prior personal experience may make it difficult for some adults ever to be attracted to activity in parks and outdoor spaces.

9. Discussion

It is evident that there are many challenges in determining how much difference might be made to activity levels of different populations and sub-groups by appropriate changes to planning, design and management of outdoor spaces. As described at the start of this paper with reference to social ecological models (see Figure 1), there are many factors involved in understanding people's activity levels. The relative contribution that can be made by environmental design is likely to vary for different behaviours and for different population groups. Nonetheless, if the physical environment lacks attributes that are necessary or highly desirable for certain kinds of activity, the local population will be deprived of opportunities to be healthy. Such inequality of opportunity to exercise outside may be contributing to wider patterns of health inequalities, where higher deprivation levels and lower socio-economic status are consistently associated with poorer health. Nelson et al. (2008) and Bull et al. (2010) have called for greater use of clear, well-conceptualized models of the behaviour and context, matched with the appropriate scale and measurement of variables, to test the interactions and pathways among personal, social and environmental factors in relation to physical activity.

The studies described above suggest that inner urban areas may be particularly constraining for outdoor activity by young children and especially for poorer communities. Rural and small town communities may offer a richer range of affordances for children, eliciting greater activity, as Kyttä's (2004) work suggests. However, the evidence starting to be accumulated by researchers like Mackett (2007) and Moore and Cosco (2010) suggests that providing local and readily accessible open spaces with sufficient environmental quality and variety to encourage children's play can offer a freedom of access outdoors that elicits greater activity levels in childhood. In turn, such planning and design efforts may contribute to greater likelihood of maintaining active use of the outdoors in adult life, even for those growing up in cities and inner urban areas.

The evidence on older people's outdoor use suggests that well managed urban areas may in many cases offer better support for walking than rural or small communities. The kinds of provision one might expect from well managed areas, including high quality paths or sidewalks, well managed traffic and attractive, well maintained, accessible parks with facilities such as toilets, offer good environments for maintaining healthy activity into old age (Aspinall et al., 2010; Sugiyama & Ward Thompson, 2008).

Nevertheless, much of the evidence accumulated suggests that, while access to a supportive physical environment is a necessary condition for people to be physically active, it is not sufficient on its own to elicit recommended levels of physical activity in the adult community (e.g., Giles-Corti & Donovan, 2002). Environmental planners and designers need to find ways to offer an appropriate 'environmental fit' for a range of personality types, cultures, backgrounds and aspirations. Despite the evident complexity of undertaking such research, we need to understand environmental experience better so as to inform environmental design. If the focus is

on walking, which is by far the most common physical activity outdoors, then it is important to explore whether there is greater potential to increase utilitarian walking or to increase recreational walking in different groups, since the evidence suggests these activities need quite different kinds of environmental support. Further, where environmental interventions increase use of an outdoor area or open space for walking, we need to know whether increased levels of activity within that environment will reflect people becoming more active or will simply displace the activity people already undertake.

The theoretical frameworks outlined earlier in this paper offer useful ways to conceptualise how the environment might afford or thwart opportunities for action, even though there remains a need to understand these relationships better. We will want to know how the scale and grain of the environment matters for different aspects of physical activity and different populations. These relationships are likely to be complex, with planning level issues at regional, community and neighbourhood level playing a role, but also with very local, fine-grained details of house, garden, street and open space potentially making a difference. We also need to understand what aspirations individuals and groups have that may be taken up or abandoned because of varying environmental support.

9.1. The value of affordance as a concept

Moore and Cosco (Cosco, 2007; Moore, 1974; Moore & Cosco, 2007, 2010) have drawn on concepts of affordance and behaviour settings in their studies of children's activity in different play settings to analyse systematically what it is about the design of different physical elements that attract or deter use and activity. Although these are aims that have long interested designers, the value of a sound theoretical underpinning to the gathering of empirical data has provided an opportunity for new understandings. Affordance as a concept is particularly useful

for understanding children's engagement with their environment. Reviewing early work by Barker and Wright (1955), who observed that children are frequently drawn into open spaces for running and playing ('open spaces seduce children'), Heft (2010) describes how affordance helps in understanding the qualities of environmental features that influence action.

The attraction of opportunities for running, balancing, throwing, digging, splashing, breaking, building, swinging, etc. that different physical environments offer may be constrained by varying social and cultural norms, but less so for young children than for adults. Outdoor environments seem likely to offer many of these opportunities in greater abundance and variety than indoors. In the context of public health concerns about sedentary behaviour, lack of physical exercise and the need for fine as well as gross motor skill development in children, it would seem vital to develop environmental designs that afford as many positive kinds of activity as possible.

Considering the wider urban environment and adult populations, the work of Gehl and colleagues (Gehl, 2007) has helped to demonstrate how behaviour observation and mapping of affordances can offer persuasive evidence for urban planning and design to encourage pedestrian use and potentially, as a result, more walking. In the context of a world-wide ageing demographic, there is growing interest in what kinds of environments support outdoor activity for older people. Here again, the concept of affordance is particularly useful in exploring the issues.

Behaviour settings as units of analysis to understand the affordance of places for physical activity offer the potential for developing a setting taxonomy that is sensitive to different kinds of activity for different age groups. The beginnings of such an approach have been outlined by Southwell (2004), as have the practical implications for developing designs in outdoor environments for older people (Southwell, 2007).

Methods such as conjoint analysis, described earlier (Aspinall et al., 2010) offer valuable opportunities for simulating future scenarios. As Little has said: “It would be intriguing to see how such simulated changes could generate new personal projects or activity preferences that may not have occurred [before]... This process could be used to detect changes likely to increase the affordances not only of current projects but also of those that have been shelved and those that have been newly instigated by awareness of new affordances and places that beckon.” (Little, 2010, p. 176).

9.2. Places that attract or deter

One challenge in understanding what kinds of environments support or elicit physical activity is that what attracts people outdoors and encourages them to be active is not the opposite of what prevents them. Research has shown that these outcomes are based on different constructs (Aspinall et al., 2010; Ward Thompson, 2007). Thus, while barriers to outdoor activity may be seen by individuals as insurmountable, or not worth the effort to overcome, removal of those barriers will not necessarily result in those same individuals being more active in the absence of attractors to outdoor activity. On the other hand, as Sugiyama et al. (2010) suggest, certain attractors (such as those found in a large, high quality parks) may be sufficient to elicit outdoor activity, even if there are barriers (such as distance) to be overcome. Designers need to understand both what is necessary and what is sufficient to encourage active outdoor use, and research needs to tease apart the strength or importance of these varying factors for different groups or individuals (Giles-Corti & Donovan, 2002; Ward Thompson, 2007, 2010a).

Two questions arise in this context: what are the kinds of environments that attract different people to be active, and what kinds of activities do people want or aspire to do? While personal projects may help considerably with understanding the latter, and affordance as a

concept mediates between the former and the latter, other theoretical approaches may also offer insights into what it is that attracts people. In particular, there is value in the idea of a spontaneous response to certain environments that is elicited, regardless of what was planned in advance: walking or running barefoot at the water's edge on a sandy beach, for example. Are there qualities in certain kinds of open space that bring out a desire to be active, that lure people to do more rather than less, that elicit a sense of freedom or delight that calls people out into the landscape and encourages them to engage in energetic ways with that landscape? If, as was suggested above, this is true of children, what opportunities for action by adults might different environments afford?

In the US context, Thaler and Sunstein (2008) have promoted a 'nudge' approach to behaviour change, now increasingly popular in UK policy development. It involves learning what will encourage rather than mandate certain types of behaviour and supporting healthy options in this way, nudging behaviour in a certain direction through what Thaler and Sunstein call the 'choice architecture' of the context in which decisions are made. The examples of choice architecture used in relation to physical environment have tended to focus on comparatively constrained contexts, such as school canteens and the order in which food is displayed, to encourage healthy food choices. There is an opportunity for future research to focus on outdoor physical activity and the challenges of a more unconstrained (and unconstrainable) environment in exploring what might encourage people to be more active. The theories outlined earlier offer useful ways to conceptualise these possibilities in more detail.

10. Conclusion

The recent strategic review of health inequalities in England is unequivocal on the value of green and natural open spaces for population level health: "green space and green

infrastructure improve mental and physical health and have been shown to reduce health inequalities” (Marmot, 2010, p. 130). Moreover, the report makes a clear policy recommendation for “improving the availability of good quality open and green spaces across the social gradient (Marmot, 2010, p. 30).

If one of the goals for public health is to increase the amount of physical activity people choose to engage in, then walking for recreation is one area with great potential; and the evidence suggests that the aesthetic quality of environments may play a key role in eliciting or inhibiting this physical activity. Yet, there is still comparatively little research that focuses on what it is about landscape perception and experience that elicits activity and physical exercise or energetic behaviours. Are there places that might elicit more active behaviour spontaneously if designed in the right kind of way, or is this an unlikely outcome for targeted design interventions?

It seems clear that for many, if not most, people of all ages, getting outdoors leads to greater levels of activity than remaining inside buildings. For this reason, the attractiveness of open spaces – often associated with natural elements in the environment - and the kinds of barriers that the environment may present – from physical constraints such as heavily trafficked roads to social constraints such as fear of personal crime – are important. But apart from the work by Aspinall et al. (2010), there is still comparatively little research that attempts to understand the relative importance of these different factors in relation to people’s behaviours. How much of a barrier is sufficient to deter a person’s activity; and how much of an attraction is necessary to elicit new levels of activity? If people are to be encouraged to engage more in maintaining their own health, as Wanless (2004) suggests, then it is precisely in this kind of area that good theory, as well as evidence from interventions, is needed.

The success of studies by architects and planners such as Lynch (1971), Gehl (1987; Gehl & Gemzøe, 1996) and Moore (1986; Moore & Cosco, 2010) in informing design practice suggest that the results of research need to be presented in ways that are familiar, accessible and attractive to designers if they are to be taken up by the design professions. Conversely, gaps between evidence and practice are likely to occur where environmental research outcomes are not explicitly translated into recommendations for planning and design practice. Without such recommendations, the World Health Organisation's promotion of health impact assessment for policies and plans (see <http://www.who.int/hia/about/defin/en/index.html>) cannot be effectively implemented. There is a need to address the issues at a variety of scales, from urban region and town or city, through neighbourhood scale to the details of streets, parks and squares or individual homes and gardens. Beyond the important contribution that robust evaluation of environmental interventions can make (Bull et al., 2010), Southwell (2004) has highlighted the need for 'designerly' ways of researching that allow for ready translation of findings into practice, particularly at the detailed level. The theories and methods described in this paper point to some potential ways forward, exemplified by studies that have drawn on them.

The specificity of place, and the role that design can play in creating salutogenic environments, remain important areas where research is needed to offer a better understanding of opportunities for action in every sense of the word. Given the health crisis in the western world, this effort is increasingly urgent.

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List of Figures

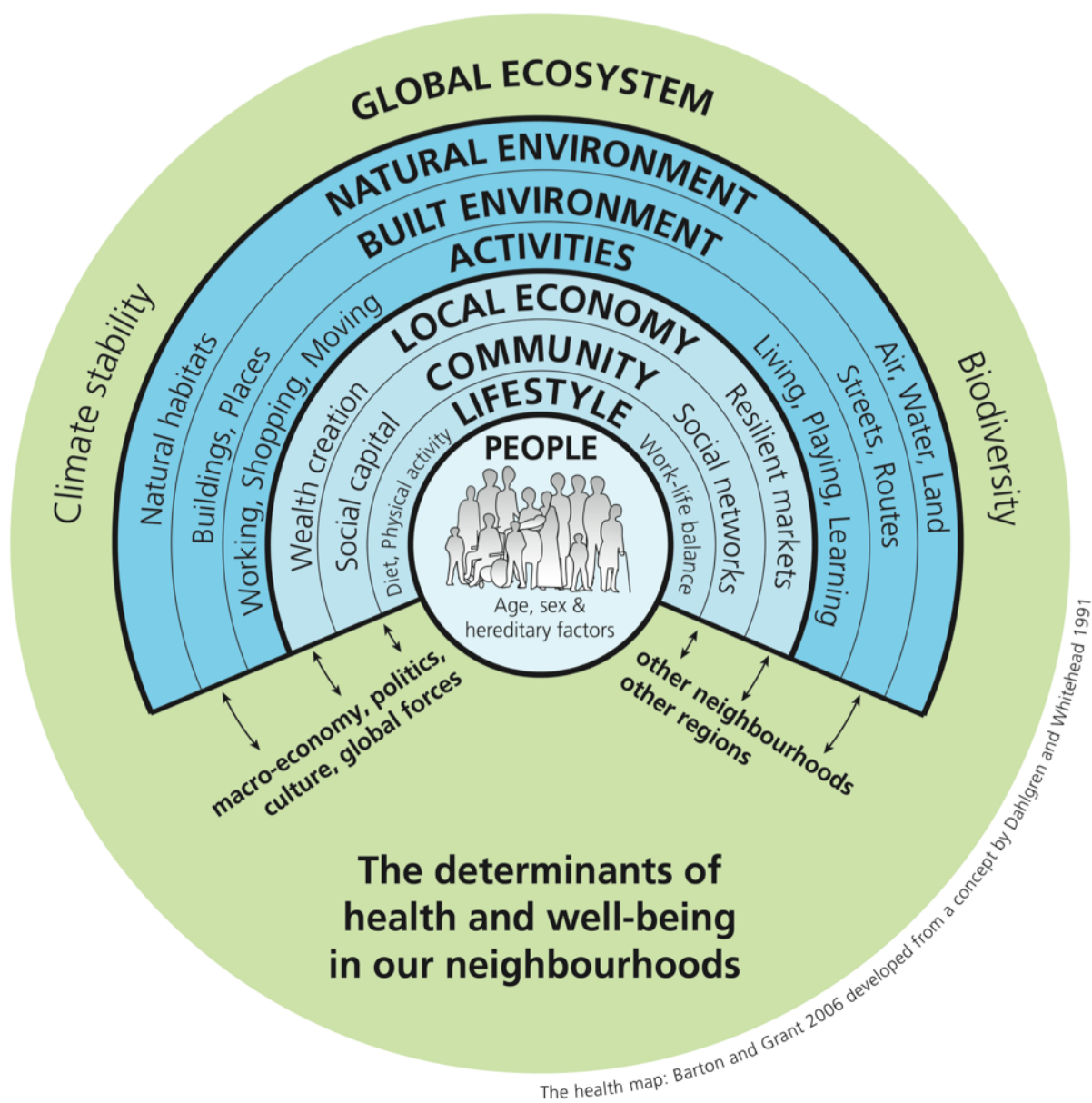


Figure 1. The Health Map – a model of public health. From Barton and Grant (2006), after Dahlgren & Whitehead (1991), reproduced with the authors' permission.

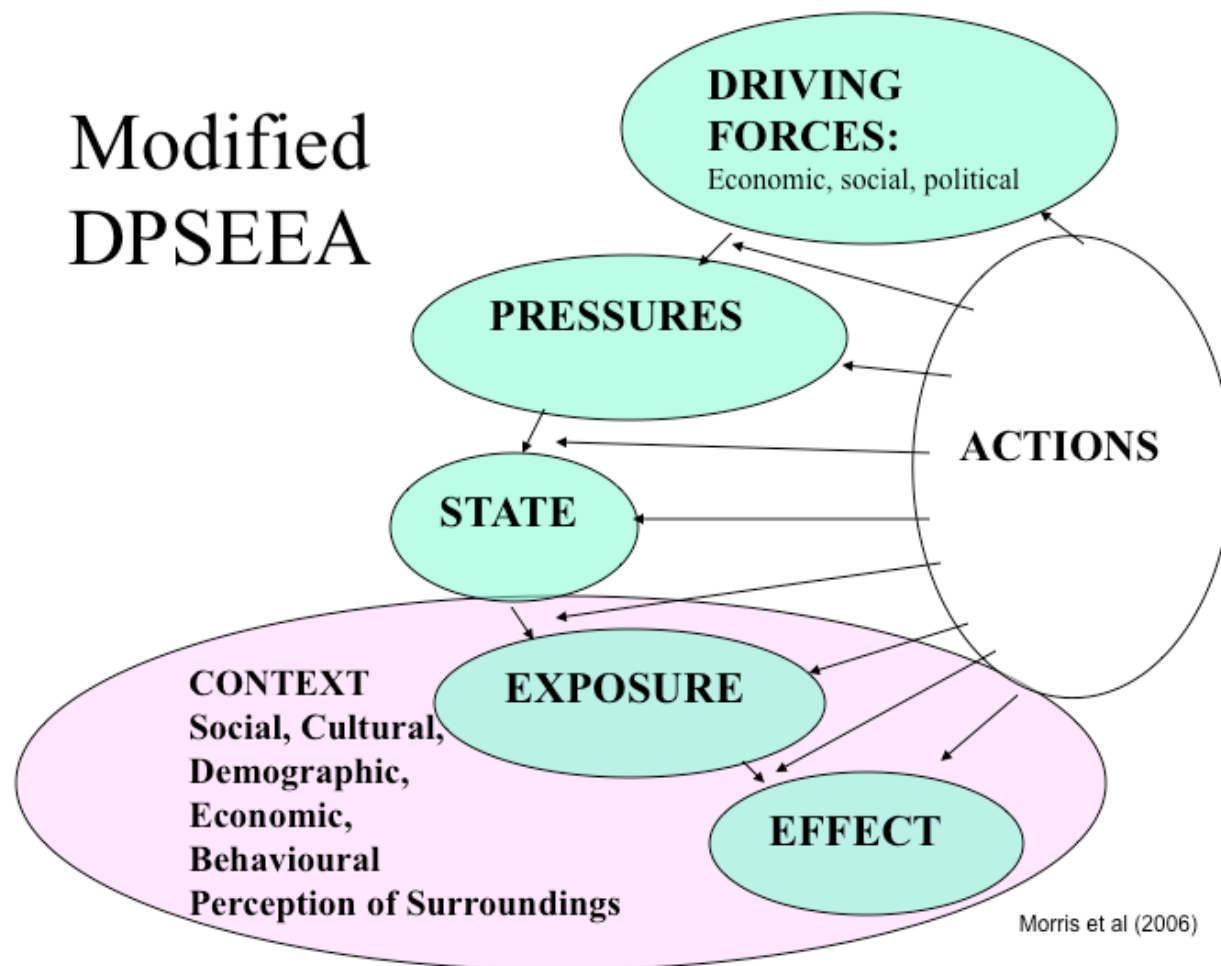
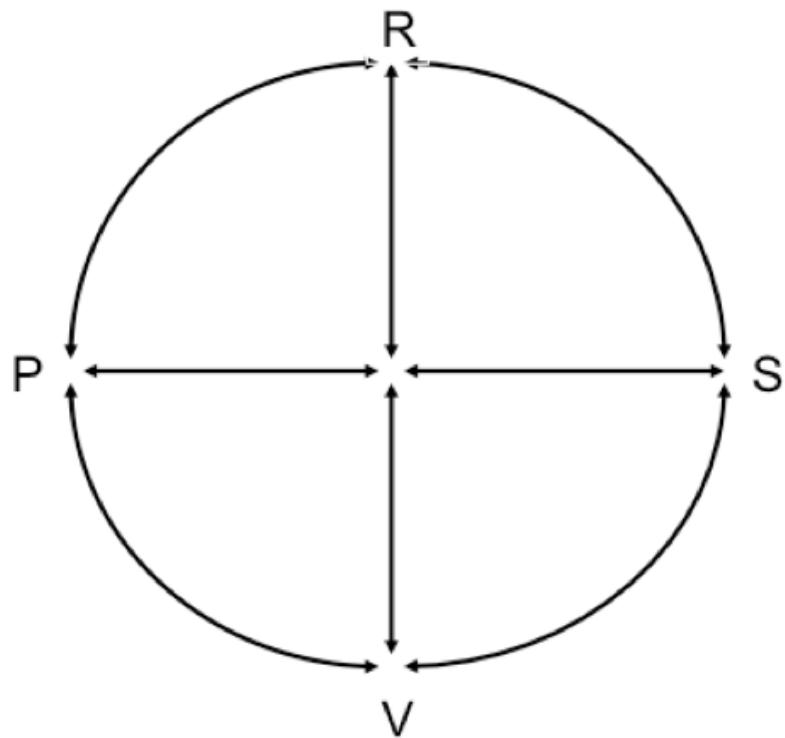


Figure 2. The modified DPSEEA model. - a model for strategy in environmental health.

From Morris et al., (2006), reproduced with the authors' permission.



Resources are what you have to work with; these include human and physical resources *and* their motivations and aims

Scores describe the process leading to the performance

Valuation analyzes the results of action and possible selectivity and decisions. The term "valuation" is one coined to suggest the action-oriented as well as the decision-oriented aspects of V in the cycle

Performance is the resultant of the scores and is the "style" of the process

Figure 3. The RSVP cycle. Redrawn after Halprin (1969).



Figure 4. Crown Center Square Fountain, Kansas City, MO. © Charvex, reproduced by permission, see

http://en.wikipedia.org/wiki/File:Crown_Center_Square_Fountain_Kansas_City_MO.jpg.